

CLAIMS

1. An optical disk control device comprising:
 - a converging projecting means that converges and projects a light
 - 5 beam via an objective lens to an information carrier having a plurality of information surfaces;
 - a focus moving means that, by moving the objective lens, moves the focal point of the light beam converged by the converging projecting means in a direction normal to the surface of the information carrier;
 - 10 a focus error detecting means that generates a focus error signal in response to the positional displacement of the focal point of the light beam with respect to the surfaces of the information carrier;
 - a focal point passage detecting means that detects that the focal point of the light beam has passed the surface and the information surfaces
 - 15 of the information carrier;
 - a reversal instruction means that outputs a reversal instruction using the output signal from the focal point passage detecting means;
 - a driving signal generating means, that, along with outputting a signal to the focus moving means to move the objective lens toward the
 - 20 information carrier, switches the signal so as to move the objective lens away from the information carrier in response to the reversal instruction, and outputs that signal;
 - a controlling means that, using the focus error signal, controls the focus moving means such that the focal point follows each of the
 - 25 information surfaces of the information carrier; and
 - a focus pulling-in means that switches an object of the operation from the driving signal generating means to the controlling means, and lets the focus moving means perform a focus pulling-in action.
- 30 2. The optical disk control device according to claim 1, further

comprising:

a learning means that detects and learns the amplitude of the focus error signal; and

5 a property correcting means that corrects the gain properties of the control by the controlling means, such that the control action after pulling focus is stabilized, using the information learned by the learning means when passing the focal point.

3. The optical disk control device according to claim 1, further
10 comprising a reflected light quantity detecting means that detects a signal corresponding to the amount of light reflected from the information carrier, wherein the focal point passage detecting means detects passage of the focal point based upon the output signal from the reflected light quantity detecting means.

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4. The optical disk control device according to claim 1, wherein the driving signal generating means outputs a signal having a slope of the driving waveform that changes when switching the signal in response to the reversal instruction.

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5. The optical disk control device according to claim 3, further comprising:

an amplitude detecting means that detects the amplitude of the focus error signal;

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a spherical aberration regulating means that sets the amount of spherical aberration of the focal point of the light beam that is converged by the converging projecting means, according to the target surface; and

an information surface detecting means that detects the target surface from the plurality of information surfaces of the information carrier,
30 using the output signal from the amplitude detecting means.

6. The optical disk control device according to claim 5, further comprising a phase relationship detecting means that detects the phase relationship between the focus error signal and the reflected light quantity signal based upon the level of the reflected light quantity signal from the reflected light quantity detecting means when the focus error signal takes a maximum value and a minimum value and the maximum value of the reflected light quantity signal from the reflected light quantity detecting means, wherein the information surface detecting means detects the target surface from a plurality of information surfaces of the information carrier, based upon the phase relationship output from the phase relationship detecting means.

7. The optical disk control device according to claim 6, wherein the phase relationship detecting means detects the phase relationship between the focus error signal and the reflected light quantity signal under the condition that the level of the reflected light quantity signal from the reflected light quantity detecting means is at least a predetermined value when the focus error signal takes a maximum value and a minimum value.

8. The optical disk control device according to claim 1, further comprising a movement amount managing detecting means A that manages and detects that the focal point moves a predetermined amount after the focal point passage detecting means detects passage of the focal point, wherein the reversal instruction means outputs a reversal instruction based upon the output signal from the movement amount managing detecting means A.

9. The optical disk control device according to claim 1, further comprising:

a rotation driving means that rotatively drives the information carrier at a prescribed rotational velocity; and

a rotation number managing detecting means that manages and detects that the information carrier has come to a standard position after
5 rotating for a predetermined number of rotations, the standard position being a position of the information carrier when the focal point passage detecting means has detected passage of the focal point, wherein the reversal instruction means outputs a reversal instruction using the output signal from the rotations number managing and detecting means, in
10 addition to the output signal from the movement amount managing detecting means A.

10. The optical disk control device according to claim 8, further comprising an information surface discriminating means that
15 discriminates whether or not the surface that the focal point passage detecting means has detected is the target surface for which focus pulling-in is to be performed, wherein the reversal instruction means outputs a reversal instruction using the output signal from the information surface discriminating means in addition to the output signal from the
20 movement amount managing detecting means A.

11. The optical disk control device according to claim 1, further comprising:

an S-shape polarity discriminating means that, when the focal
25 point position detecting means detects the focal point position of the light beam with regard to the information surfaces of the information carrier, outputs an S-shaped signal formed by a maximum value and a minimum value of the focus error signal and discriminates the order in which the minimum value follows the maximum value or the order in which the
30 maximum value follows the minimum value; and

a focal point position detecting means that detects the focal point position of the light beam with respect to the information surfaces in the information carrier.

5 12. The optical disk control device according to claim 11, further comprising a reflected light quantity detecting means that detects a signal corresponding to the quantity of light reflected from the information carrier, wherein the focal point position detecting means detects the focal point
10 information carrier under the condition that the level of the reflected light quantity signal from the reflected light quantity detecting means is at least a predetermined value when the focus error signal takes a maximum and a minimum value.

15 13. The optical disk control device according to claim 1, further comprising:

a surface discriminating means that discriminates that the surface detected by the focal point passage detecting means is a predetermined surface included in the information carrier;

20 a movement amount setting means that sets the amount of movement of the objective lens based on the output signal from the surface discriminating means;

a movement amount managing detecting means B that manages and detects that the focal point moves for a predetermined amount B set by
25 the movement amount setting means after the focal point passage detecting means detects passage of the focal point; and

a reversal instruction means that outputs a reversal instruction using the output signal from the movement amount managing detecting means B.

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14. The optical disk control device according to claim 13, further comprising:

a rotation driving means that rotatively drives the information carrier at a predetermined rotational velocity; and

5 a rotation number managing detecting means that manages and detects that the information carrier has come to a standard position after rotating for a predetermined number of rotations, the standard position being a position of the information carrier when the focal point passage detecting means has detected passage of the focal point, wherein the
10 reversal instruction means outputs a reversal instruction using the output signal from the rotation number managing detecting means in addition to the output signal from the movement amount managing detecting means B.

15 15. The optical disk control device according to claim 1, further comprising:

a movement amount managing detecting means A that manages and detects that the focal point moves for a predetermined amount A after the focal point passage detecting means detects passage of the focal point;

20 a surface discriminating means that discriminates that the surface detected by the focal point passage detecting means is a predetermined surface included in the information carrier;

a movement amount setting means that sets the amount of movement of the objective lens based on the output signal from the surface
25 discriminating means; and

a movement amount managing detecting means B that manages and detects that the focal point moves for a predetermined amount B set by the movement amount setting means after the focal point passage detecting means detects passage of the focal point, wherein the reversal
30 instruction means outputs a reversal instruction in response to either the

timing at which an output signal is generated from the movement amount managing detecting means B or the timing at which an output signal is generated from the movement amount managing detecting means A.

5 16. The optical disk control device according to claim 15, further comprising:

a rotation driving means that rotatively drives the information carrier at a predetermined rotational velocity; and

10 a rotation number managing detecting means that manages and detects that the information carrier has come to a standard position after rotating for a predetermined number of rotations, the standard position being a position of the information carrier when the focal point passage detecting means has detected passage of the focal point, wherein the reversal instruction means outputs a reversal instruction using the output
15 signal from the rotation number managing detecting means, in addition to the output signal from the movement amount managing detecting means A and the output signal from the movement amount managing detecting means A.

20 17. The optical disk control device according to any one of claims 9, 14 and 16, further comprising a rotations number setting means that calculates a predetermined number of rotations in response to the rotational velocity of the information carrier, and sets the calculated predetermined number of rotations in the rotation number managing
25 detecting means.

18. The optical disk control device according to any one of claims 8, 13 and 15, further comprising a velocity setting means that calculates the velocity that will drive the objective lens in response to the rotational
30 velocity of the information carrier, and sets the calculated velocity in the

driving signal generating means.